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ABSTRACT

There is a scarcity of research evaluating the effect of the classroom exposure of students to historical and/or female role models in the sciences. This paper describes a unit involving an historical female role model that was incorporated into a college-level science course. The goals of the unit were to provide an historical context for scientific research, explore social implications of the modern extension of this research, and provide a female role model prior to 1970. The unit consisted of a lecture, two assigned readings, and a discussion period. Data were qualitative and the main source of this data came from journals kept by participating students (n=13). Journals were coded for themes. This was a hypothesis-generating study. The operative hypothesis was that the students would report an improved awareness of women in science and of the social and historical context of the sciences. Due to a confounding factor, no conclusions could be drawn as to whether the students saw science as masculine, feminine, or androgynous, or whether there were any changes in opinion during the time of the experiment. Includes study outline and list of journal questions submitted to the students. (Contains 13 references.) (PVD)

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A College Biology Unit on the Evolution of Genetics, Incorporating a Historical Female Scientist and Current Social Applications.

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Rationale:

Many studies on gender equity in science education have recommended increasing the exposure of students to women in the sciences who may serve as role models. Access to female role models in high school mathematics has been associated with the exposed students increasing their enrollment in mathematics courses, and in science-related majors. Such exposure has also been associated with higher achievement in college mathematics and chemistry (Oakes, 1990). Working mothers, and dissatisfied home-making mothers have been associated with an increased selection of non-traditional majors and careers by daughters. (Betz & Fitzgerald, 1987). A lack of role models may contribute to the negative attitude which teen-age girls express towards science. However, there is some disagreement as to whether female role models will actually improve the retention of these girls in the sciences. (Kahle & Meece, 1994).

In addition to the possible benefit to female students, there is also evidence that there is benefit in exposing males to female role models. Studies have shown that many students of both genders see mathematics and science as more relevant for boys than for girls. Sex-stereotyping of math and science is more common in boys than in girls (Oakes, 1990). Exposing middle school and high school students to female career role models has resulted in increased positive attitudes of both girls and boys towards women in science and towards science (Smith & Erb, 1986). This is important because high school boys are among those most able to convince girls to take courses in the physical sciences (Kobulla, 1988). In addition, those boys who become scientists will be the colleagues of any of the girls who may choose a career in science. As such, if the scientific community is to become more equitable with respect to gender, there is value in considering the attitudes of both boys and girls towards women in science.

There is a scarcity of research evaluating the effect of classroom exposure of students to historical and/or female role models. This is particularly true regarding fields other than mathematics, such as the science curriculum. Studies on the use of role models in the classroom are also rare beyond the post-secondary or high school level. This paper is concerned with an intervention being conducted at the college level.

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Goals:

The purpose of this study is to incorporate a unit involving a historical female role model into a college level science course, so as to observe the response of the students. The goals of the unit are 1) to provide a historical context for scientific research, 2) to explore social implications of the modern extension of this research, and 3) to provide a female role model from before 1970.

This study is hypothesis-generating. The operative hypothesis is that the students will report an improved awareness of women in science, and of the social and historical context of the sciences.

Sample:

The unit was designed for an introductory college biology class. However, problems of access resulted in this trial being conducted with an upper level class studying research methods in psychology. The sample was of 18 students, 17 of whom were female. Of these students, 13 took part in the experiment by handing in their journals. The site of the class had been a women's college until the year of this study.

Methods:

The intervention consists of a lecture, two assigned readings, and a discussion period. The lecture topic is the genetic bases for evolutionary changes, with an emphasis on the many methods by which bacteria can alter themselves, and the medical implications of such changes (based in part on Amabile-Cuevas & Chicurel, 1993). The two assigned readings were 1) a biographical essay on the life of Louise Pearce, M.D. (1885-1959), a researcher whose studies included the progression and possible treatments for African Sleeping Sickness and Syphilis (Scholer, in publication) and 2) a news magazine article on antibiotic resistant bacteria (Nash, et. al., 1994). The discussion session is based upon the ethical concerns of medical research on animals and humans, and the availability of experimental medicines to humans with fatal diseases.

As this is a hypothesis-generating study, the data collected is qualitative in nature. The main source of data is journals kept by the participating students. This journal extends for four weeks: two weeks prior to the unit, the week of the unit, and one week post-study. The twelve questions for journal entries include: whether science has a gender, whether the student recalls a historical event or person in science, whether a relationship between historical events and current events exists in the sciences, and a weekly prompt about the classes and exercises.

The discussion period of the unit was tape-recorded, and the tapes transcribed for analysis. These will be examined at a later time.

Participation in the study is voluntary, not related to class grades, and students signed an informed-consent form before the study started. The students were required for their class to write a 'lab report' about being a subject in a research project. They were not required to hand in the journals. I was not shown these required reports.

Validity of the journal entries was confirmed by an interview with the instructor regarding the 'lab reports' the students had written about being a research subject, and an interview with one student, after the journals have been collected. Field notes were taken during these interviews.

Analysis:

The journals and transcripts were coded for themes. Particular attention was focussed on 1) attitudes towards the curriculum of the unit, 2) awareness of women as scientists, 3) awareness of societal 'engendering' of science, and 4) attitudes towards science in general. Attention was to be focussed on any indications of change in attitude by individual participants, and on any differences in reported attitudes by male and female participants. However, as noted below, this portion of the data was confounded.

Data was analyzed according to the grounded theory method (Strauss & Corbin, 1990), so as to avoid researcher bias.

Results:

The primary goal of this project was to record the student responses to a unit of biology which incorporated a historical woman scientist. The operating hypothesis was that the students would report a greater awareness of women in science and of the historical background to science. Regarding the first hypothesis, conclusions must be limited. During the validity interview, the psychology instructor stated that several students had been assigned to speculate in their 'lab reports' about the probable hypothesis to this study, and a number of the students confessed to consciously attempting to alter the results either towards or against that believed hypothesis (Dolinsky, personal communication). Due to this confounding factor, no conclusions can be drawn as to whether the students see science as masculine, feminine, or androgynous; or whether there were any changes in opinion during the time of the experiment.

However, be safely reported that all of the students answered that question

with regards to how many male and female scientists of whom they were aware. "I see science as androgynous because of things that is (sic) scientific has been discovered by men & women. Science deals with both genders." (001, question 4). "I see science [as] androgynous as a profession. In other words, I feel anyone can do it. I feel that science, however, is portrayed as masculin (sic). T.V. & movies, at least from what I've seen, show science as a man's profession." (003, question 11). Several students referred to media portrayals of scientists as their main source of information.

> When I hear the word science I think of man in a white lab coat in a lab[,] mixing some combination of chemicals. These aren't any specific qualities of science in particular that make me think this way. Society however does. On television commercials or shows the doctors, pharmacists, biologists etc are generally men. There are always men used to represent various fields of science (004, question 4).

Only one student mentioned factors other than the individuals who practice science as influencing her answer.

> My first reaction is that it is masculine. however, I believe all professions are androgynous. I say masculine only because I have heard or learned little about female scientists. I have had both male and female teachers for science though. I don't know where this comes from, it was just my initial reaction. The qualities of a scientist that would reinforce the masculine label would be: logical, conclusive, work-oriented (012, question 4).

This participant's answer echoes the ongoing discussion in feminist philosophy of science as to whether patterns of thought such as logic and scientific practice are strictly associated with the masculine gender (Longino, 1987). The rest of the participants limited their arguments to those people which they report to have seen or which they believe are practicing as scientists.

When queried about historical personages and events, the majority of the students in this trial could not recall a person related to the history of science. Those persons and events which were cited, were Darwin, Edison, Curie, a confused combination of Pasteur and Mendel, and the discovery of solar energy.

Question seven asks that the students comment on the biographical reading. This reading is about Louise Pearce, a medical biologist. With two exceptions, the tenor of the comments is animated.

> The reading was interesting because it was about her actual life, but there were a lot of concepts that I couldn't understand. ...I was however very

impressed with all that she has achieved and find it unbelievable that one person could do so much in one life time (003, question 7).

... It amazed me that she accomplished so much (and worked so hard to get where she was) and until I had read the paper--I had never heard of her. For someone who gave so much to the scientific community, it would seem to me that she deserved at least a mention in one of the numerous science classes I've had. ...(008, question 7).

...sounds like a remarkable woman. I somehow suspected that she didn't have a family. ...I wonder where her ambition came from? Why was she so excited about all these diseases and finding cures? Was she content with her work, or did she miss not having a family outside of the other two women she lived with? (012, question 7).

Of the two exceptions, one student asked "...why did you have us read this?" (010, question 7). The other reported "I didn't die of boredom.", but did not comment on the subject of the essay (008, question 7).

Each week, one of the questions is to comment on the week's classes and exercises. The purpose was to obtain student feedback on the curriculum and the project. The majority of the responses recount exams, stress under the number of assignments, and the topics covered in class. "This week's classes were long and never ending. I've been getting everything in on time, but definitely feel the pressure as the year is coming to an end." (003, question 6). "This week in class we reviewed internal validity in research projects. This concept was interesting to me." (005, question 5). "This week I learned about poverty." (013, question 6). A few participants actually commented on issues of presentation or teaching methods. "... Lectures have been good--lots of notes. Many of the topics were discussed using excellent examples, making the lectures more interesting." (009, question 9). "Lecture in classes were understandable." (001, question 9). The question will have to be rephrased so as to get more of the students to reflect on the curriculum of the course in question.

The tenth question was about historical impact on current scientific research. This was anticipated by the newsmagazine article, and by historical comparisons in both the lecture and the introduction to the discussion session. The results were encouraging, as ten of the thirteen participants reported examples showing that historical events are related to current concerns in science. Most related the current AIDS pandemic with past epidemics. "For example the bubonic plague wiped out millions of people years ago. Today we are faced with a new epidemic: AIDS." (008, question 10). Other students recited the standard view of scientific progress.

"What scientists have learned in the past help us to learn more and more today." (008, question 10). Of the three who did not make this connection, one described the history of women's rights, and the other two did not answer the question.

One question asked what career would be chosen, if the subject had to choose a science career. The answers given are of possible concern to psychology faculty. Although the students in this trial are all in psychology or psychology-dominated majors, only two selected fields related to their majors. One student named her chosen art therapy as a science. A criminal justice major selected forensic science. Ten of the participants selected either natural sciences, medicine, or the development of medical treatments as a science-related career. "If I had to choose a career in science it would be a researcher/experimenter who dealt with finding cures for disease and sickness. I would pick this profession because I would feel like I was doing something to help other people." (005, question 5). The remaining student reported a desire to be a rocket scientist. "I would love to work for NASA and I love space." (013, question 5). It is surprising that none of these students chose clinical or research psychology as a possible science career.

Conclusions

A version of this study will be conducted with a larger group of students in an introductory biology class. The primary goal is to further explore the use of historical context and historical female scientists in introductory science courses, with the purpose of encouraging the students to reflect upon their attitudes towards women in science and on the relations of historical events with modern science. The second goal is to determine whether the trial's association of gender and science with those who practice it, may hold up with a larger sample of college students. Given the results of the trial above, there will be some alteration of the questions: to collect demographics from what is a larger potential sample, and to encourage further reflection by the participants on the curriculum of the class and on their own reactions to the process of this experiment.

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Study outline

Distribute Informed consent forms and explain.

Start Journals 2 weeks prior to class work.

Friday prior to unit: Assign Louise Pearce reading for next laboratory meeting.
'Be prepared to discus in laboratory(***or Friday??**)--write down comments and questions for discussion--in journal if keeping journal.'

Lecture: Genetic variation and antibiotic /medication resistance.
Lecture based on: J. M. Nash, A. Park, M. Schmiedeskamp, & A. Purvis (1994)
'The Microbes Strike Back" TIME 9/12/94 p.62-69
C. F. Amabile-Cuevas & M. E. Chicurel (1993) 'Horizontal Gene Transfer' American Scientist 81:332-341.

Laboratory: Ethics and medicine testing.
Small group discussion, concluded by each group reporting general conclusions to the class. Time =30-45 min.
Topic: Pearce worked with Brown to develop an animal model for African Sleeping Sickness. These animals were then used to test possible anti-trypanosome medications. the successful medicine was then tested on humans in the Belgian Congo in Africa. The humans tested ranged in progression of the illness from mildly sick to dying. After early trials were successful (although the formerly dying often became blind), Pearce urged the Rockefeller Institute to make the medicine available in general. However, further small tests were continued for several years.
Current parallels exist for the development of AIDS and cancer medications.
Questions: Is animal model testing ethical?
When should human testing be started?
When should a medicine be available for the general public?
Are placebo tests (sugar pills to half of the patients) ethical?

Journal Questions

1. Draw a scientist and describe.

2. Describe your experience(s) studying historical event(s) or people in science. What person or event was studied? What effect did this have on your understanding and/or interest in the material of the course you were taking?

3. Comment on this week's classes and exercises. What was interesting/difficult/worked for you?
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4. Do you see science as masculine, as feminine or as androgynous (of both genders)? What qualities of science cause you to identify science this way?

5. If you had to choose a career related to science, what job would you choose, and why?

6. Comment on this week's classes and exercises. What was interesting/difficult/worked for you?
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7. Questions and comments on the reading, biography of Louise Pearce.

8. Laboratory--biography of a woman in science.

9. Comment on this week's classes and exercises. What was interesting/difficult/worked for you?.
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10. Do historical events in science have any relation to current concerns? Support your answer with an example.

11. Do you see science as masculine, as feminine, or as androgynous? What causes you to have this opinion?

12. Comment on this week's classes and exercises. What was interesting/difficult/worked for you?